Portion Size and Practical Approaches to Obesity Prevention

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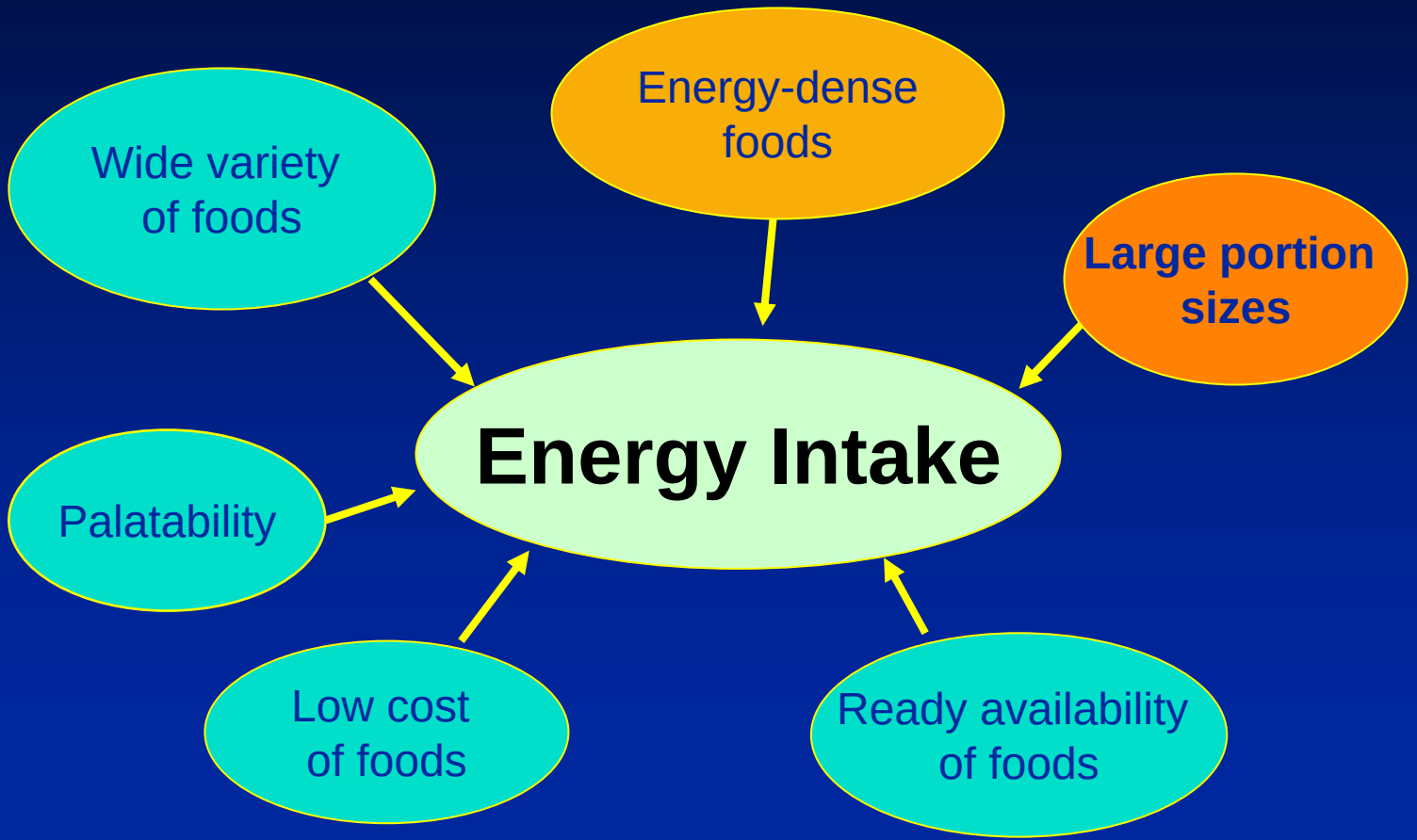
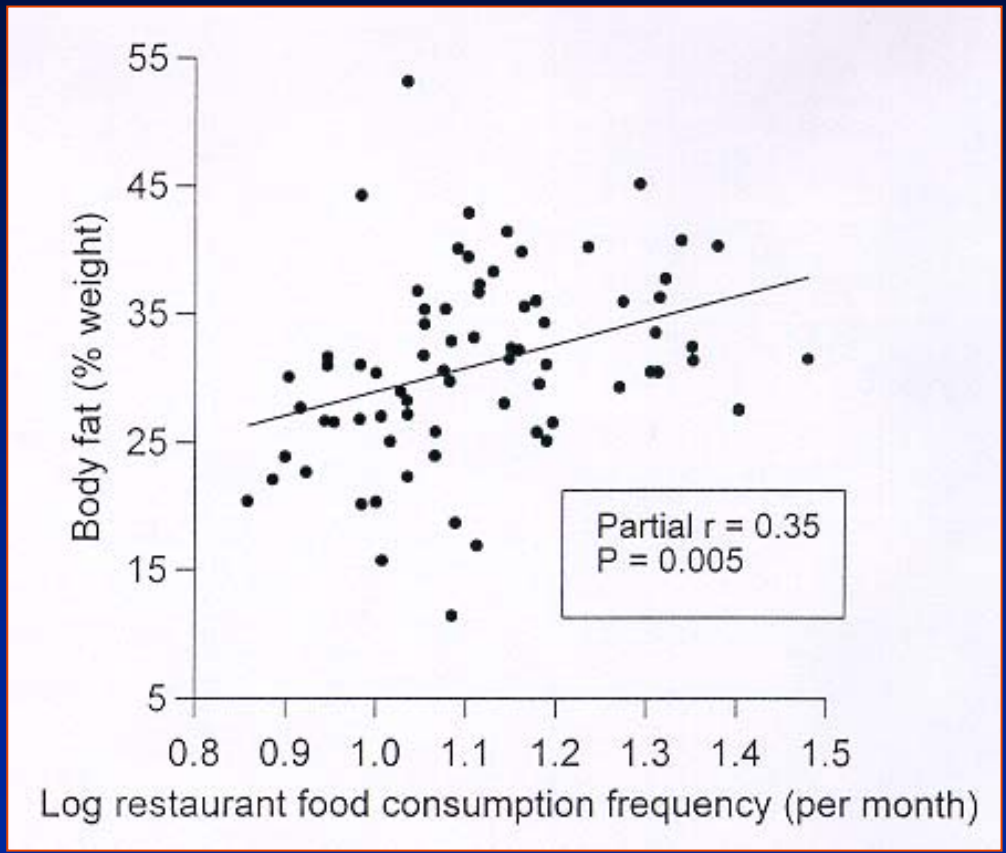
Portion size is one of many possible environmental influences on intake



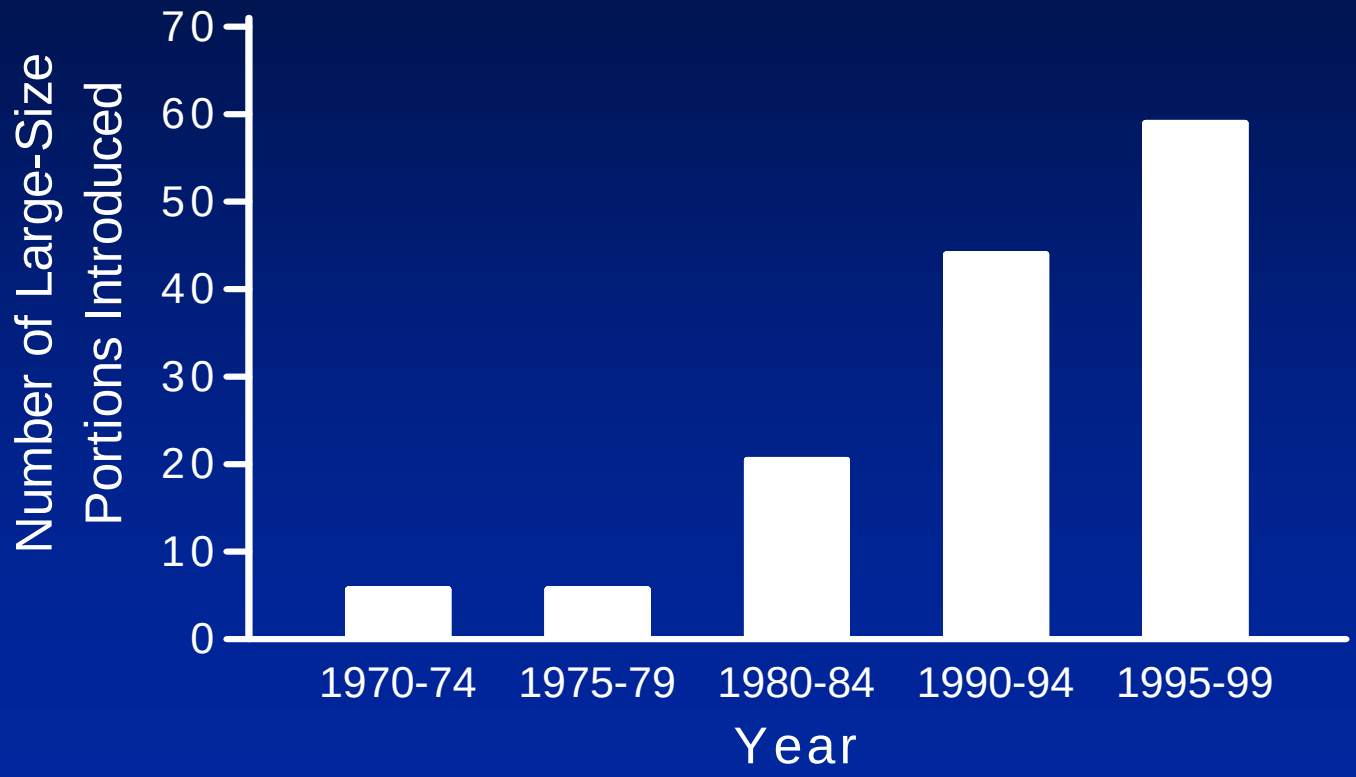
Eating out was associated with increased body fat



Why?

McCrory et al., Obesity Research, 7:564-571, 1999

Introduction of large portions coincided with increased overweight and obesity



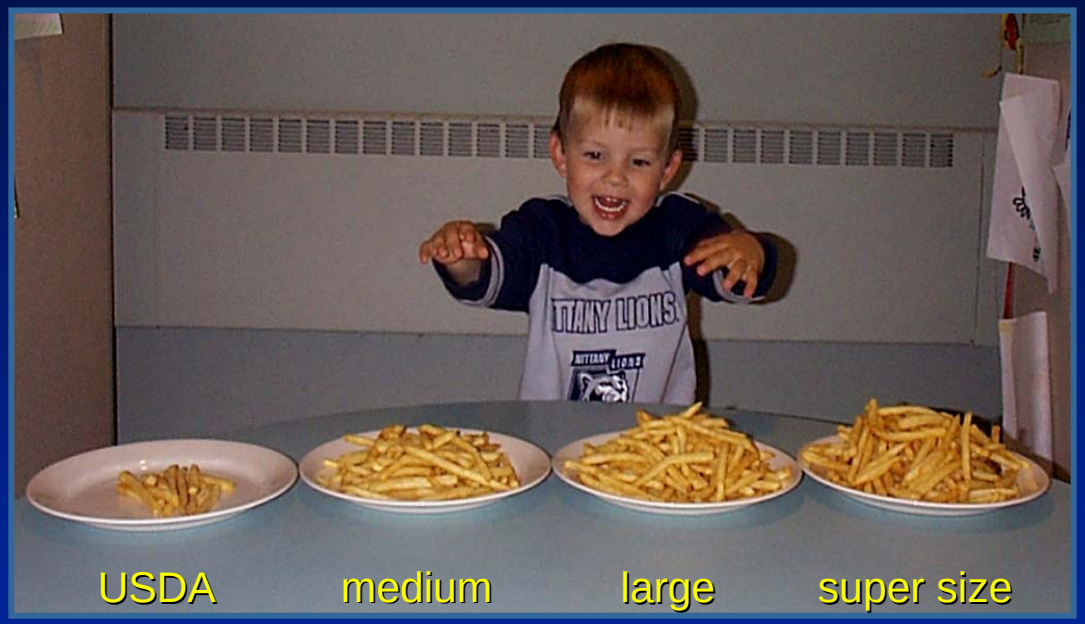
Young & Nestle, Am J Public Health, 92: 246-249, 2002

Epidemiological data indicate that portions consumed have increased

- **Nielson & Popkin (2003)** *JAMA, 289:450-453*
  - Portion sizes increased inside and outside the home
  - Biggest increase was in fast-food establishments
- **Smiciklas-Wright et al. (2003)** *J Am Dietetic Assn, 103:41-47*
  - Portions of 23 (11 beverages) out of 107 common foods increased significantly over 5 years

These studies did not examine the relationship between portion size & BMI

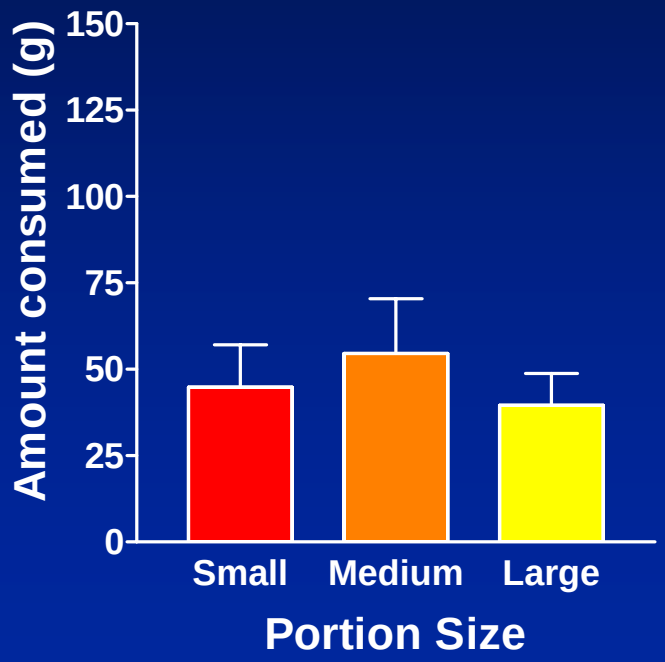
Children learn how much to eat in their food environment



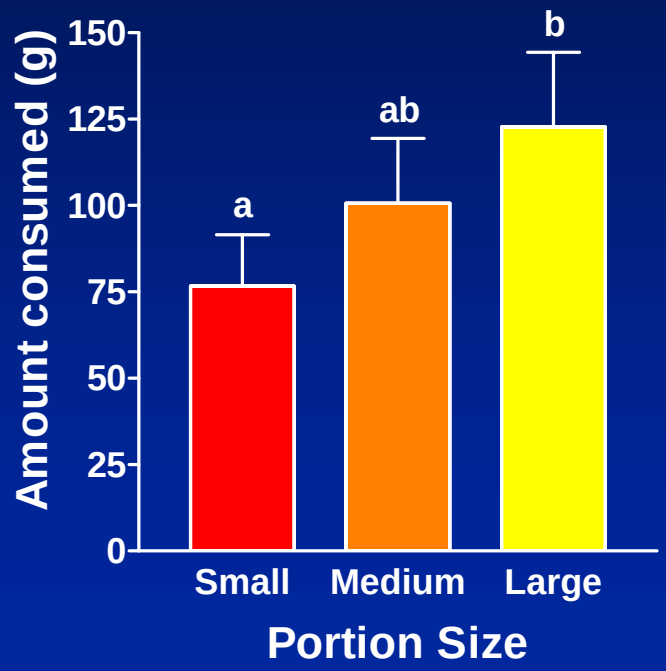
42% of adults say they base the amount they eat on the amount they are used to eating *(AICR Survey, 2003)*

Portion size affected intake in older, but not younger, children

Younger Children (mean age 3.6 years)



Older Children (mean age 5.0 years)



Rolls, Engell, & Birch, J Am Dietetic Assn, 100: 232-234, 2000

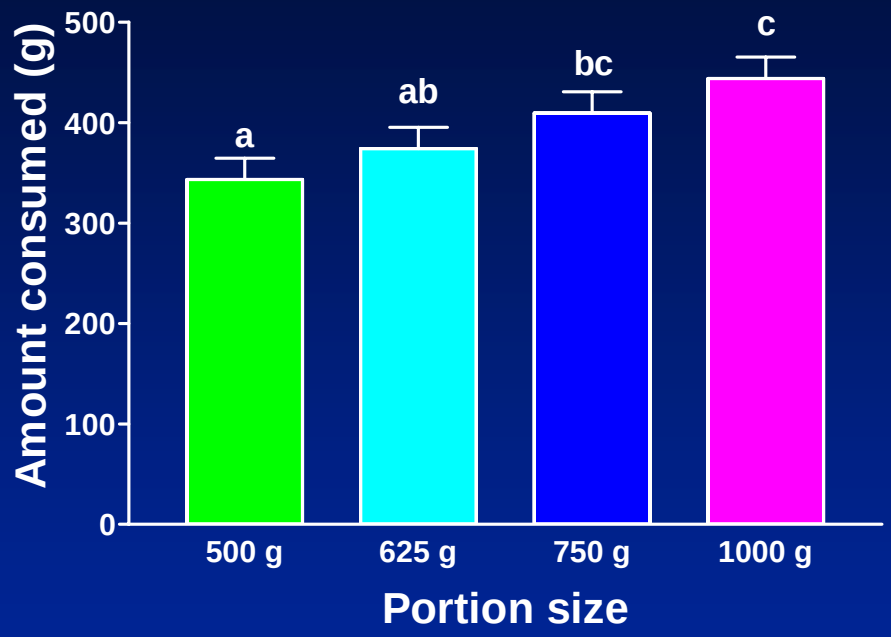
To reduce children's risk of overweight, we can shape their environments

- To influence learning about ***how much*** to eat, we can:
  - Use feeding practices to foster awareness of hunger and satiety as cues
  - Allow children to determine their own portion sizes
    - Children ate 25% less when they served themselves

Fisher, Rolls & Birch, Am J Clinical Nutrition, 77: 1164-1170, 2003

Portion size affected intake in adults

Hunger and fullness did not differ

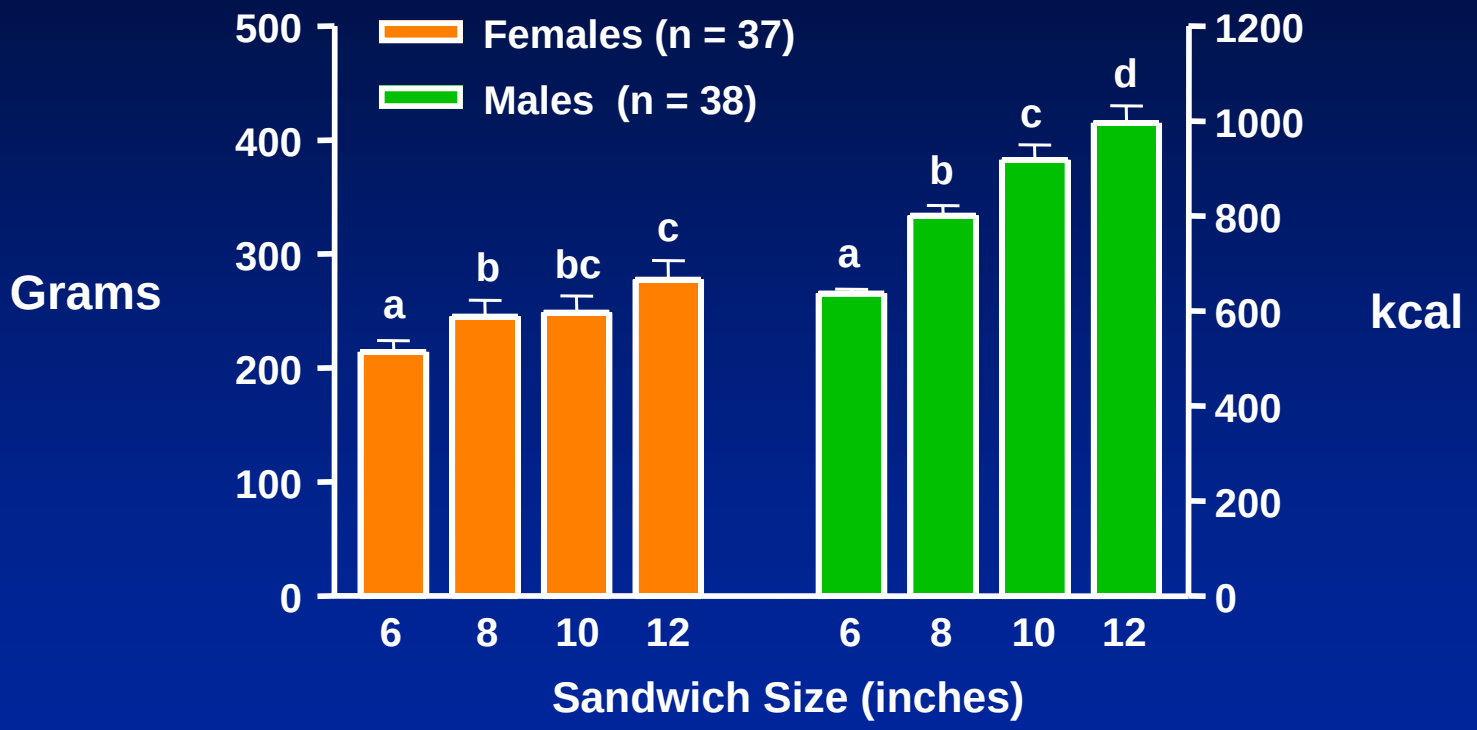


Rolls, Morris & Roe, Am J Clinical Nutrition 76:1207-1213, 2002

How does increasing the size of a unit food, such as a sandwich, affect intake?

Rolls et al, J Am Dietetic Assn, 104: 367-372, 2004.

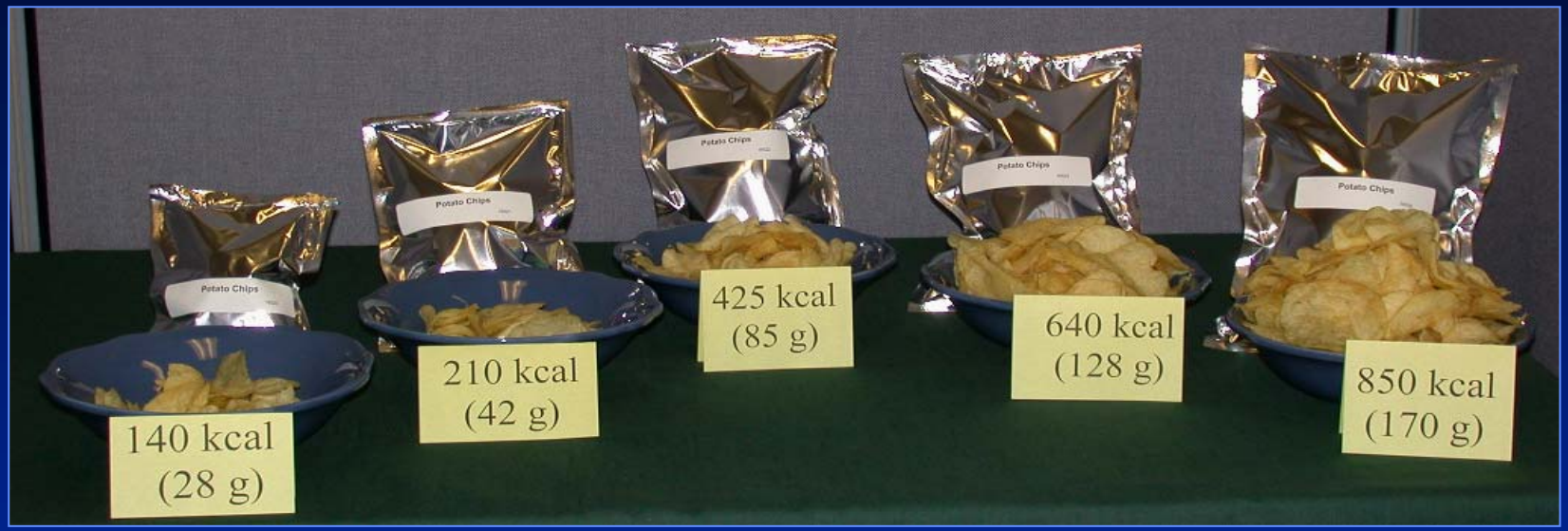
Sandwich size affected intake in women and men



Within each sex, means with different letters are significantly different ($p < 0.025$)

Rolls et al, J Am Dietetic Assn, 104: 367-372, 2004

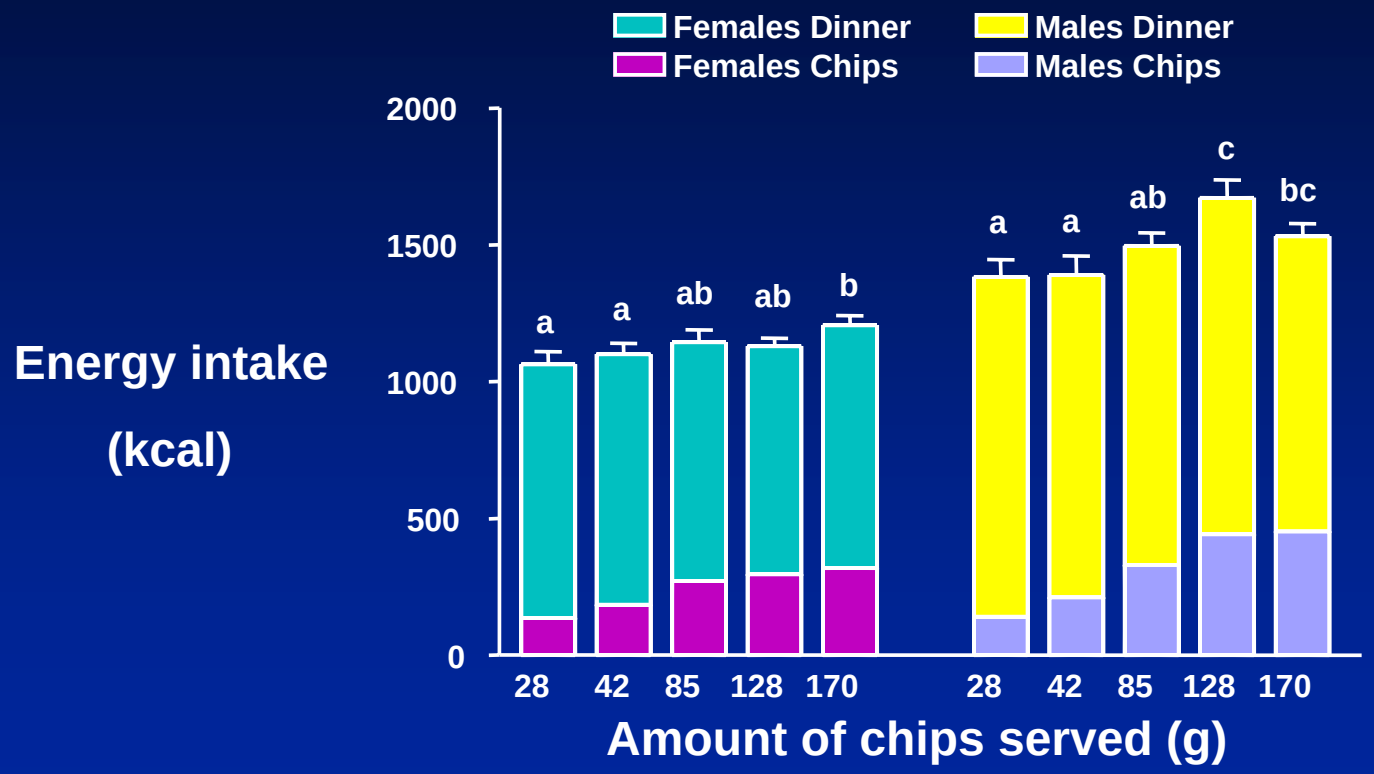
Are bigger package sizes associated with increased snack consumption?



Does snack intake affect dinner intake?

Rolls et al., Appetite, 42: 63-69, 2004

Package size affected intake



Means within each sex with different letters are significantly different ($p < 0.02$)

Rolls et al., Appetite, 42: 63-69, 2004

Does increasing the portion size of an entrée served in a cafeteria affect intake?

- **Customers: Faculty, Staff, Visitors, Students**

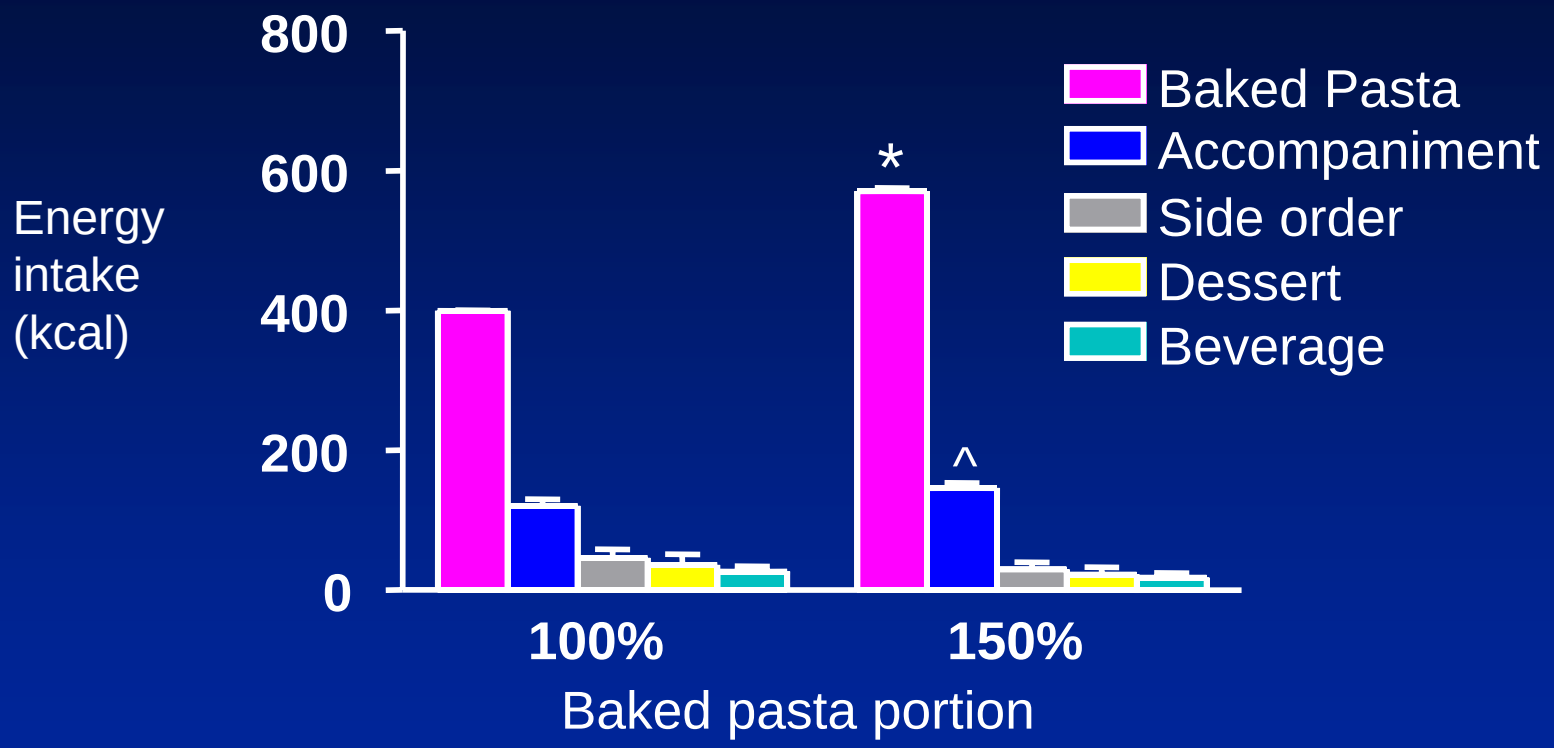
Diliberti et al., Obesity Res, 12: 562-568, 2004

A popular dish was offered in two portions on different days

Baked pasta (E.D. = 1.7)	100% portion (n = 89)	150% portion (n = 91)
Cooked weight (g)	248	377
Calories (kcal)	422	633

- Price remained constant ($4.50)
- Rated equally appropriate in size

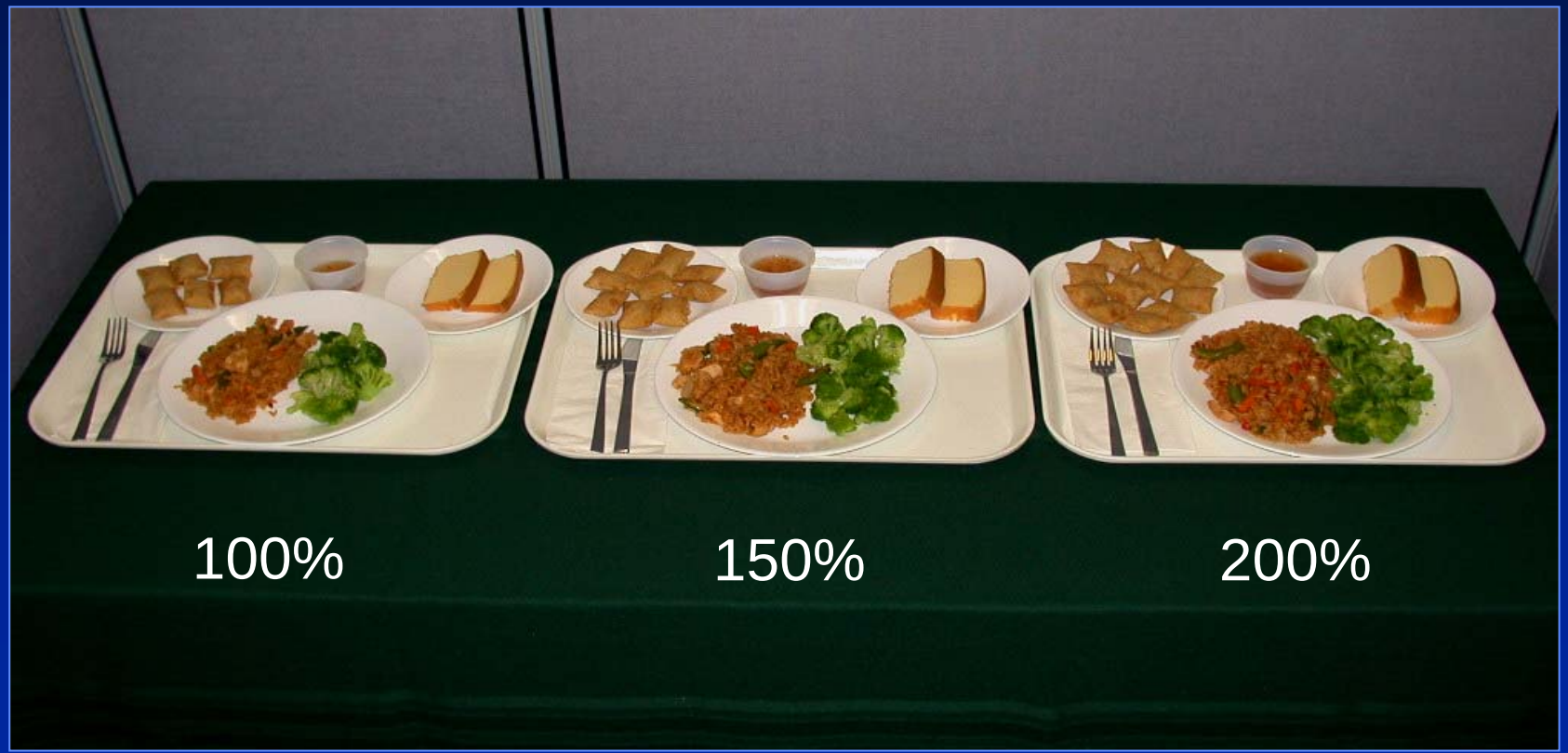
Intake of a restaurant entrée increased with portion size



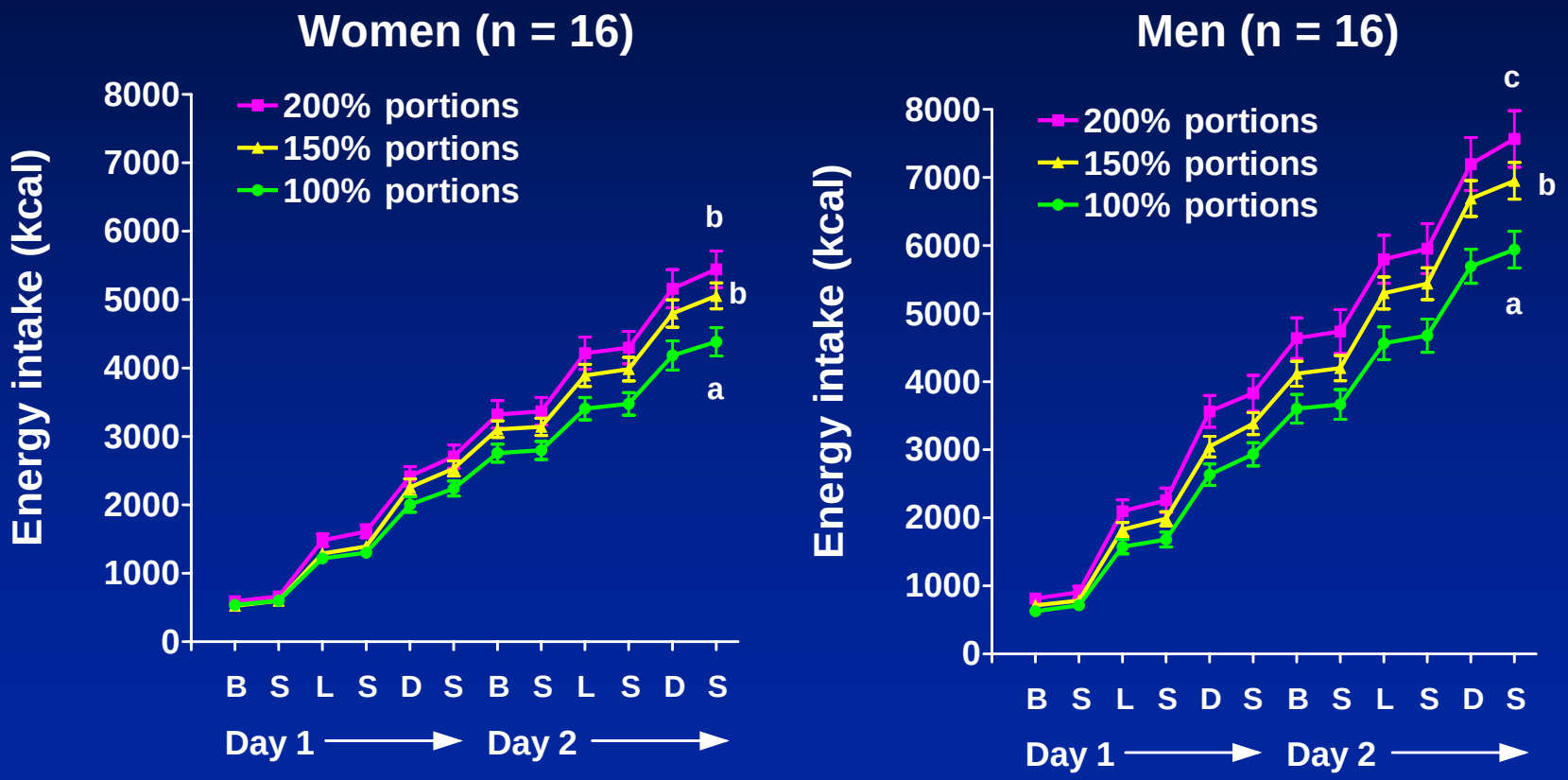
* Significantly different from 100% Portion ($p < 0.0001$)
^ Significantly different from 100% Portion ($p < 0.05$)

Diliberti et al., Obesity Res, 12: 562-568, 2004

Do effects of portion size persist over two days when all foods are varied?



Effect of portion size on energy intake persisted over two days



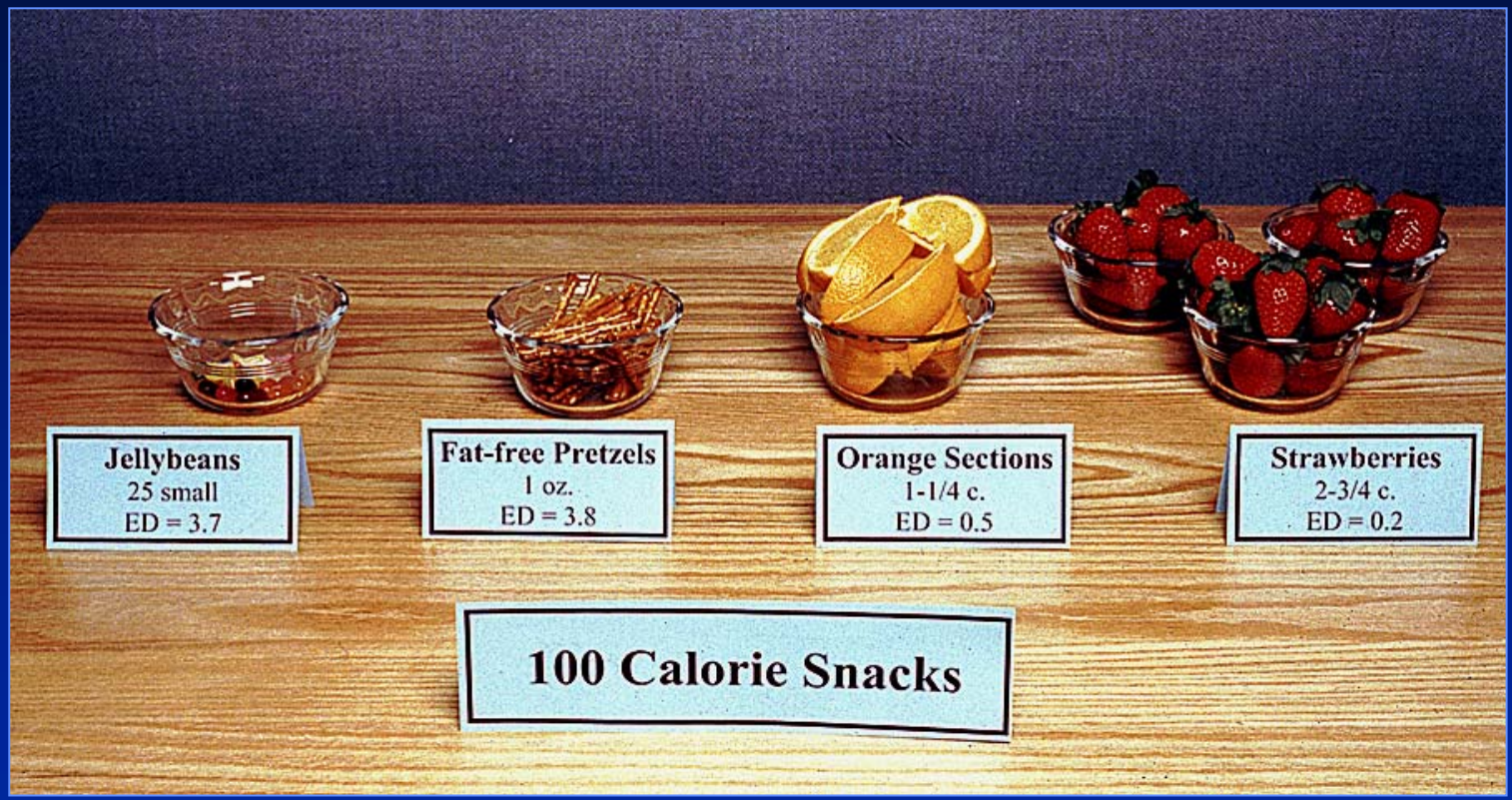
Rolls, Meengs & Roe, J. Am. Dietetic Assn. In press.

How can the influence of portion size on intake be moderated?

- Consume portion-controlled meals
  - Remove environmental cues that lead to overeating
- Reduce energy density (kcal/g)

It's still the calories!

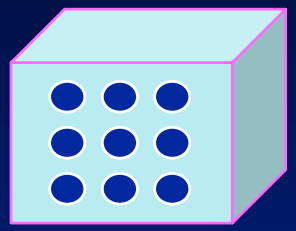
The lower the energy density (kcal/g), the bigger the portion



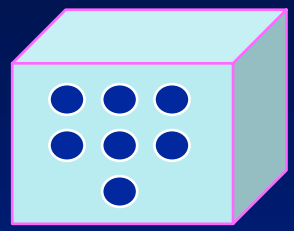
Rolls & Barnett, The Volumetrics Weight-Control Plan, Quill,2000, HarperTorch, 2003;

Rolls, The Volumetrics Eating Plan, HarperCollins, 2005

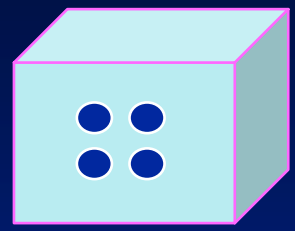
The energy density or calorie density of food components



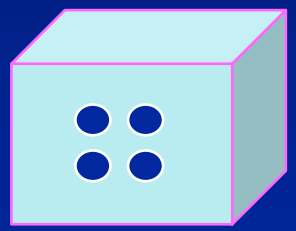
Fat
9 kcal/g



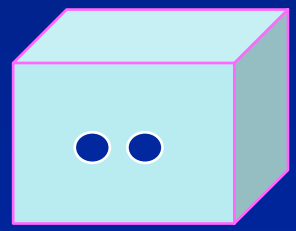
Alcohol
7 kcal/g



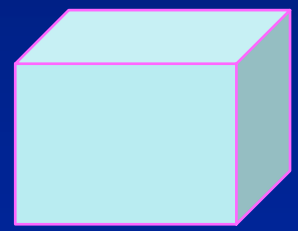
Carbohydrate
4 kcal/g



Protein
4 kcal/g



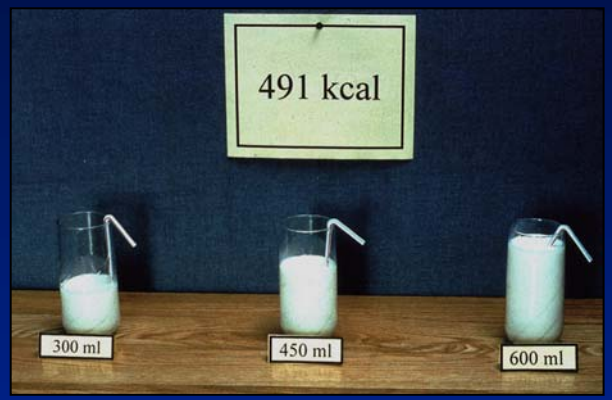
Fiber
1.5 – 2.5 kcal/g



Water
0 kcal/g

Incorporating water in food served as a first course reduces intake during the rest of the meal

- Adding water to milkshakes decreased subsequent intake



- Adding water to a casserole to make a soup decreased subsequent intake

Low ED Medium ED High ED

Summary:

- Not all large portions are associated with over-consumption
  - Low-calorie, low-energy-dense foods at the start of a meal can reduce meal energy intake
  - With these foods, bigger is better

What is the effect of reducing the energy density and portion size of all foods over 2 days?

- The 4 conditions:

ED	Portion size
100%	100%
100%	75%
75%	100%
75%	75%

- All foods were varied across the two days
- The energy content of all menus exceeded the energy requirements of the subjects

Rolls, Roe & Meengs. Am J Clin Nutr, In press

Commonly consumed foods were used for the manipulations

Low-ED, big portion

High-ED, big portion

Low-ED small

Low-ED big

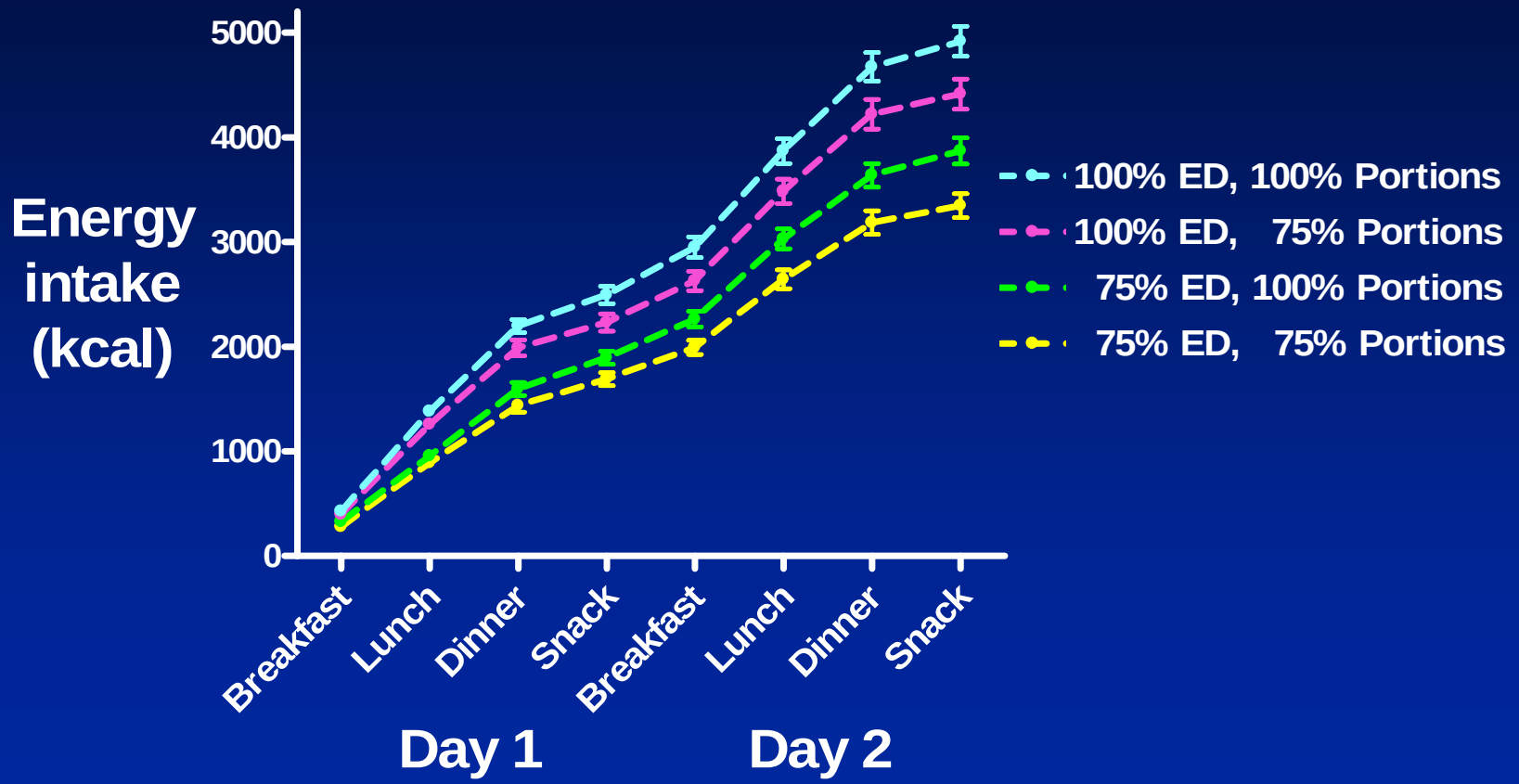
High-ED small

High-ED big

Two-day Menus

Meal	Menu A	Menu B
Breakfast	Blueberry muffin Strawberry yogurt Tea or coffee	Coffee cake Peach slices Tea or coffee
Lunch	Vegetable pizza Tossed salad Chocolate chip bar	Turkey deli sandwich Potato chips Brownie
Dinner	Bean & rice casserole Tortilla chips & salsa Ice cream	Baked pasta Green beans & garlic bread Blueberry pie
Evening Snack	Crackers & cheese Grapes or raisins	Crackers & cheese Grapes or raisins

Effects of energy density and portion size persisted over two days

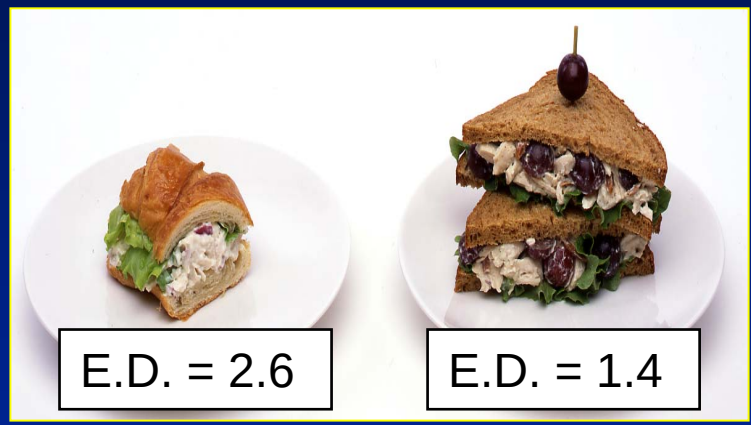


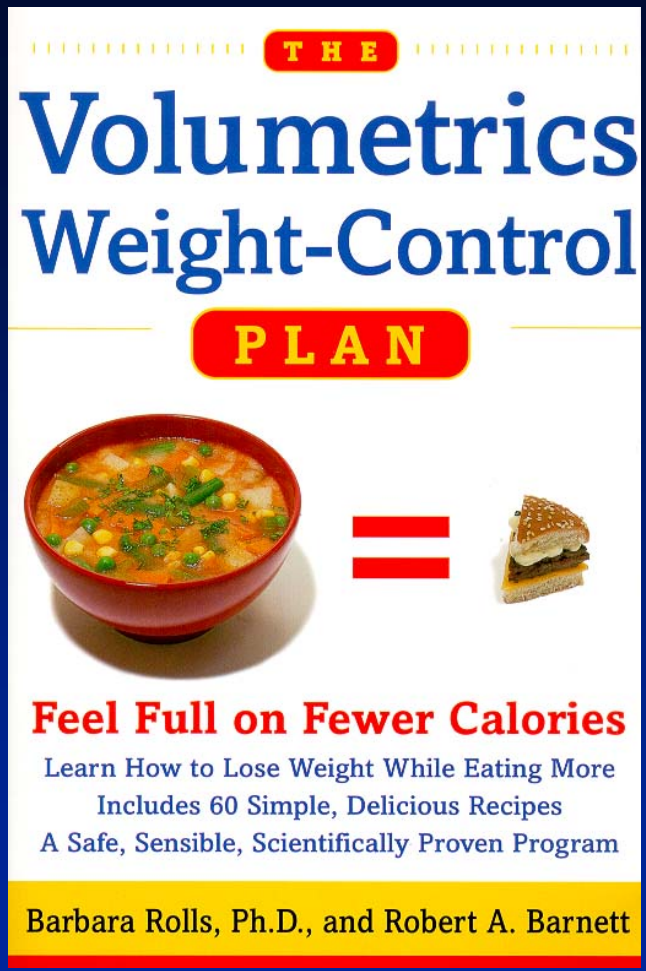
Rolls, Roe & Meengs. Am J Clin Nutr, In press

Practical Applications

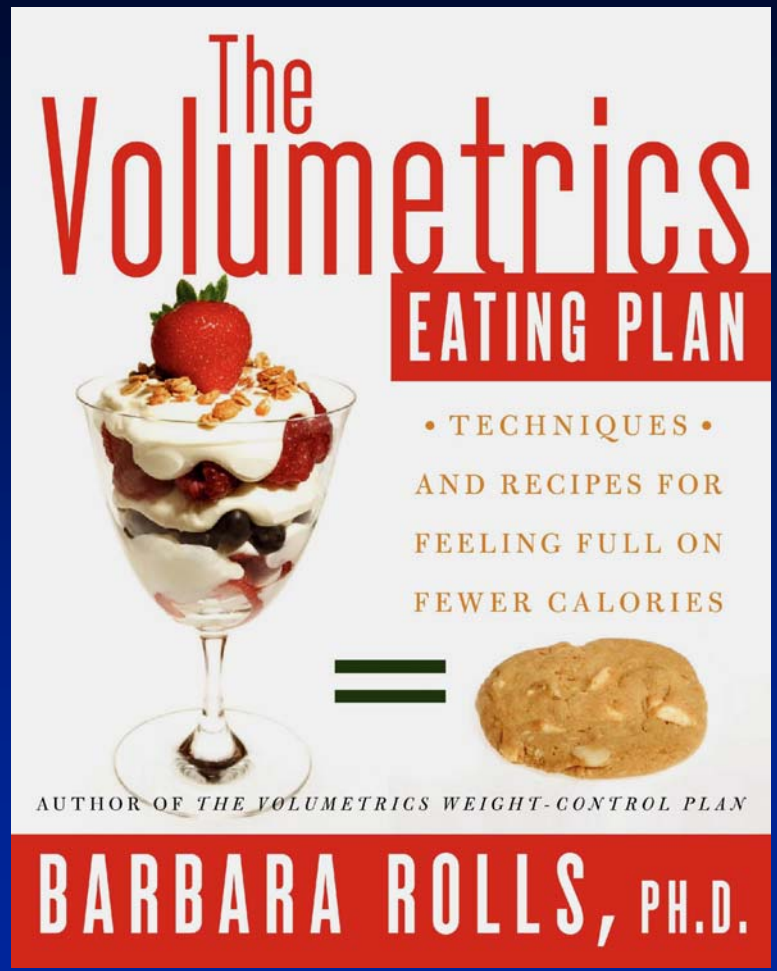
- **Large portions of energy-dense foods pose a particular challenge to the maintenance of energy balance**
- **Even small reductions in the energy density or portion size of foods are likely to decrease energy intake**
- **Messages to simply “eat less” need to be modified to include information about the impact of energy density**

275-calorie sandwich:



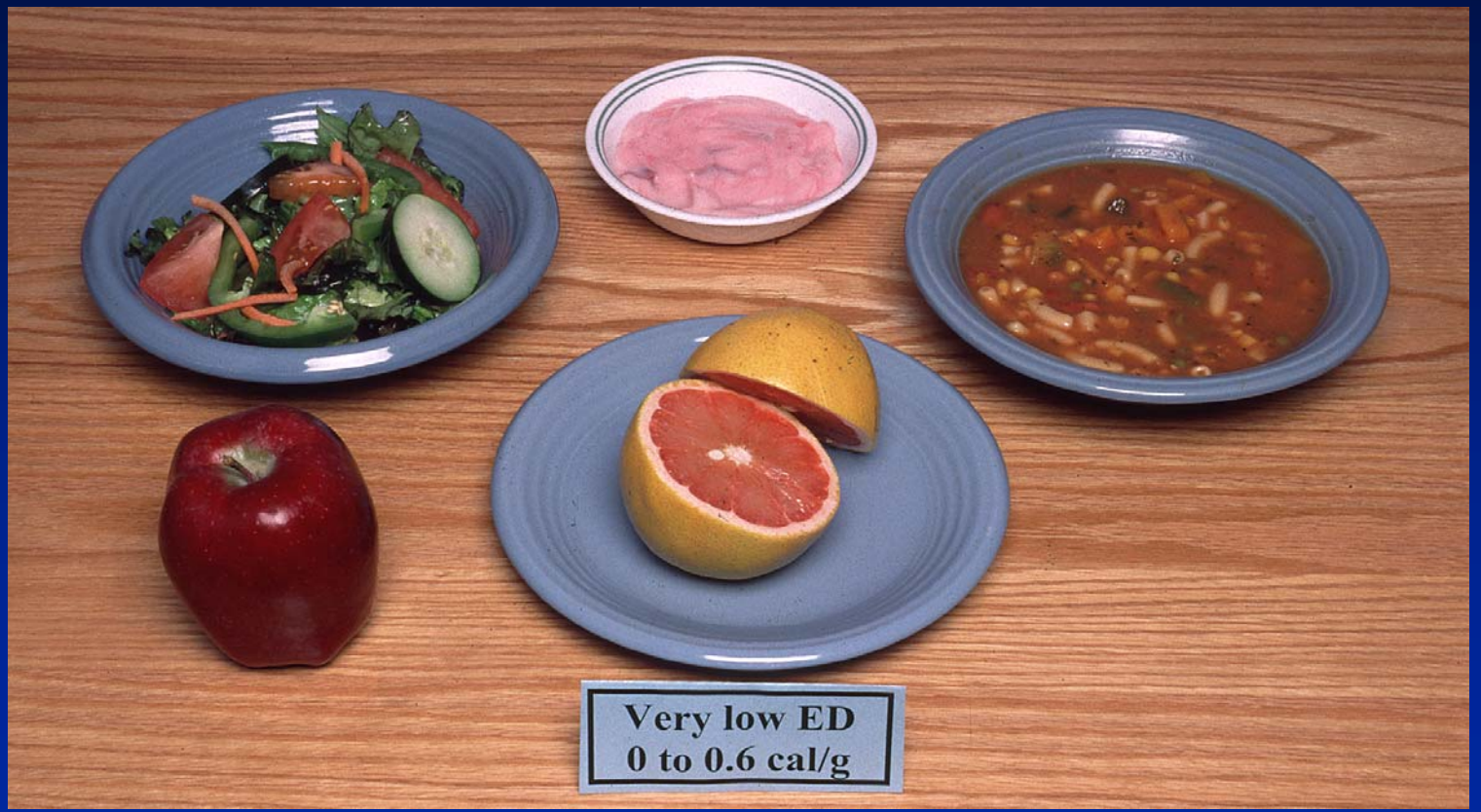


Quill, 2000 & HarperTorch 2003



HarperCollins, March, 2005

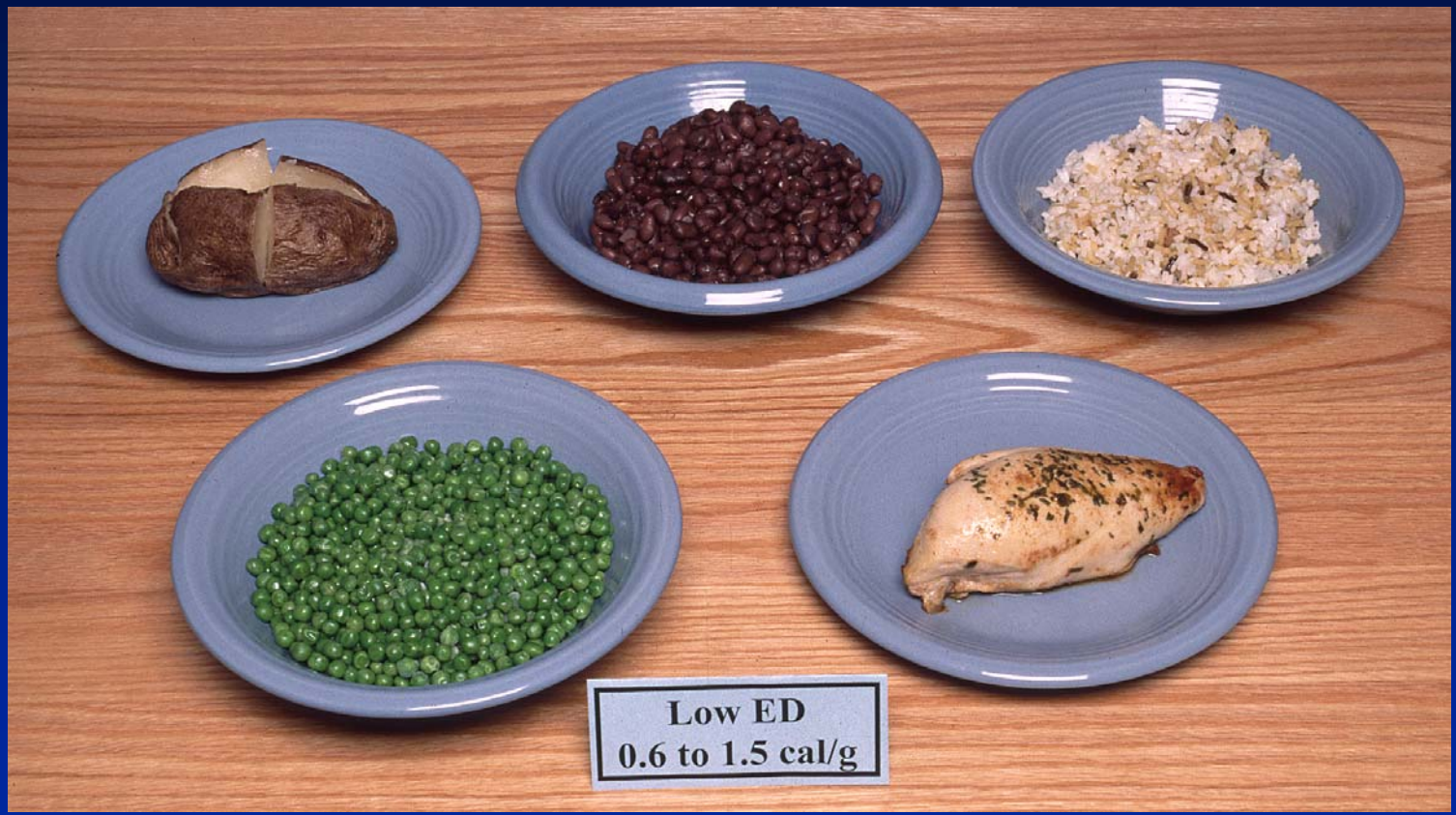
Category 1:
Can eat satisfying amounts without consuming too many calories



Rolls, The Volumetrics Eating Plan, HarperCollins, 2005

Category 2:

Many foods come from this category; Can consume relatively large portions

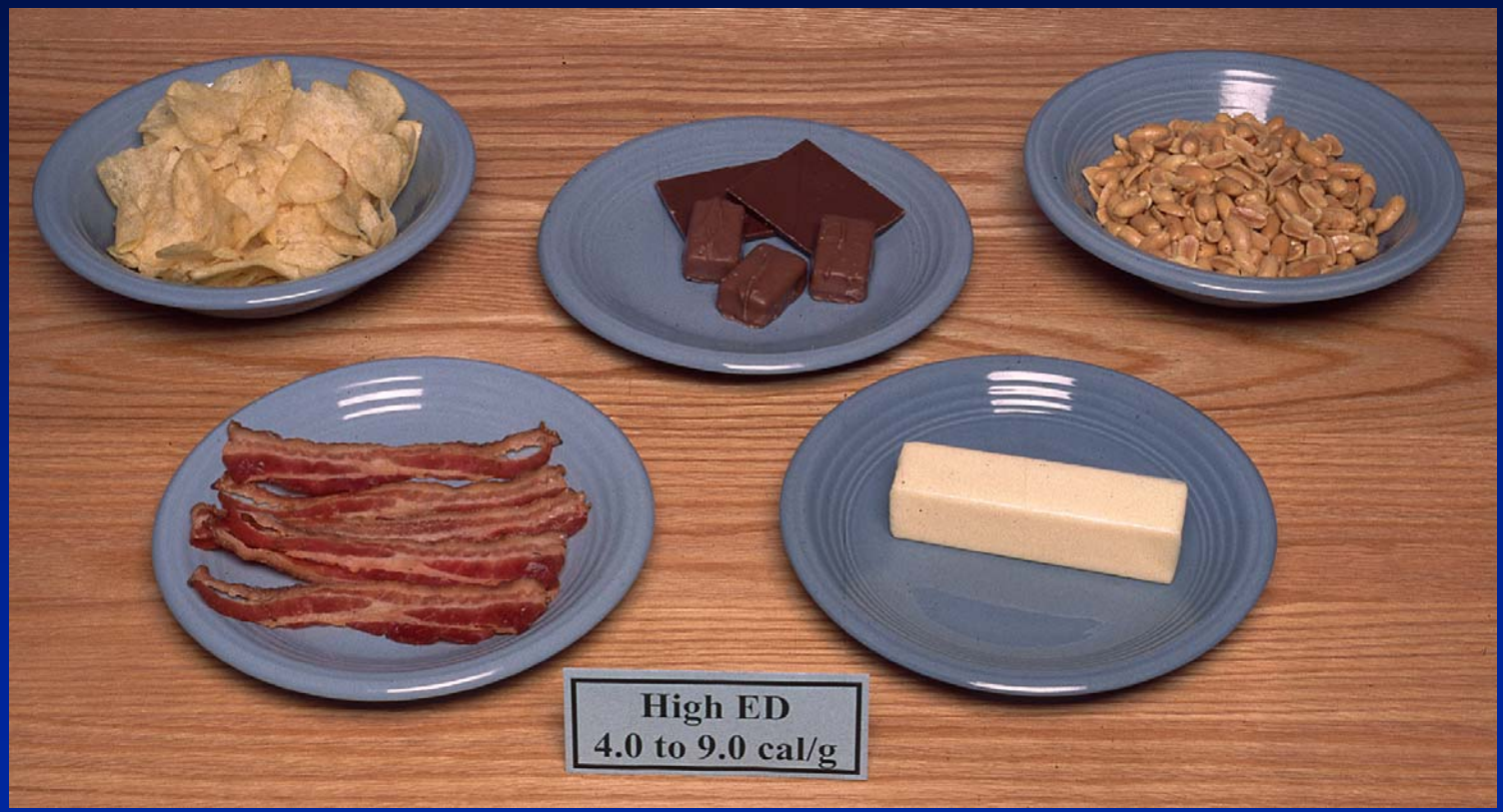


Category 3:

Be careful of portion size, especially at the high end of this broad range of foods

Category 4:

Need to manage consumption from this category; Limit portions or make substitutions



A Day of Volumetrics

Breakfast (270 calories)

Rolls, B. The Volumetrics Eating Plan, HarperCollins, 2005

Lunch (500 calories)

Rolls, B. The Volumetrics Eating Plan, HarperCollins, 2005

Dinner (500 calories)

Rolls, B. The Volumetrics Eating Plan, HarperCollins, 2005

How do two strategies to reduce the energy density of the diet affect weight management?

RF Group:

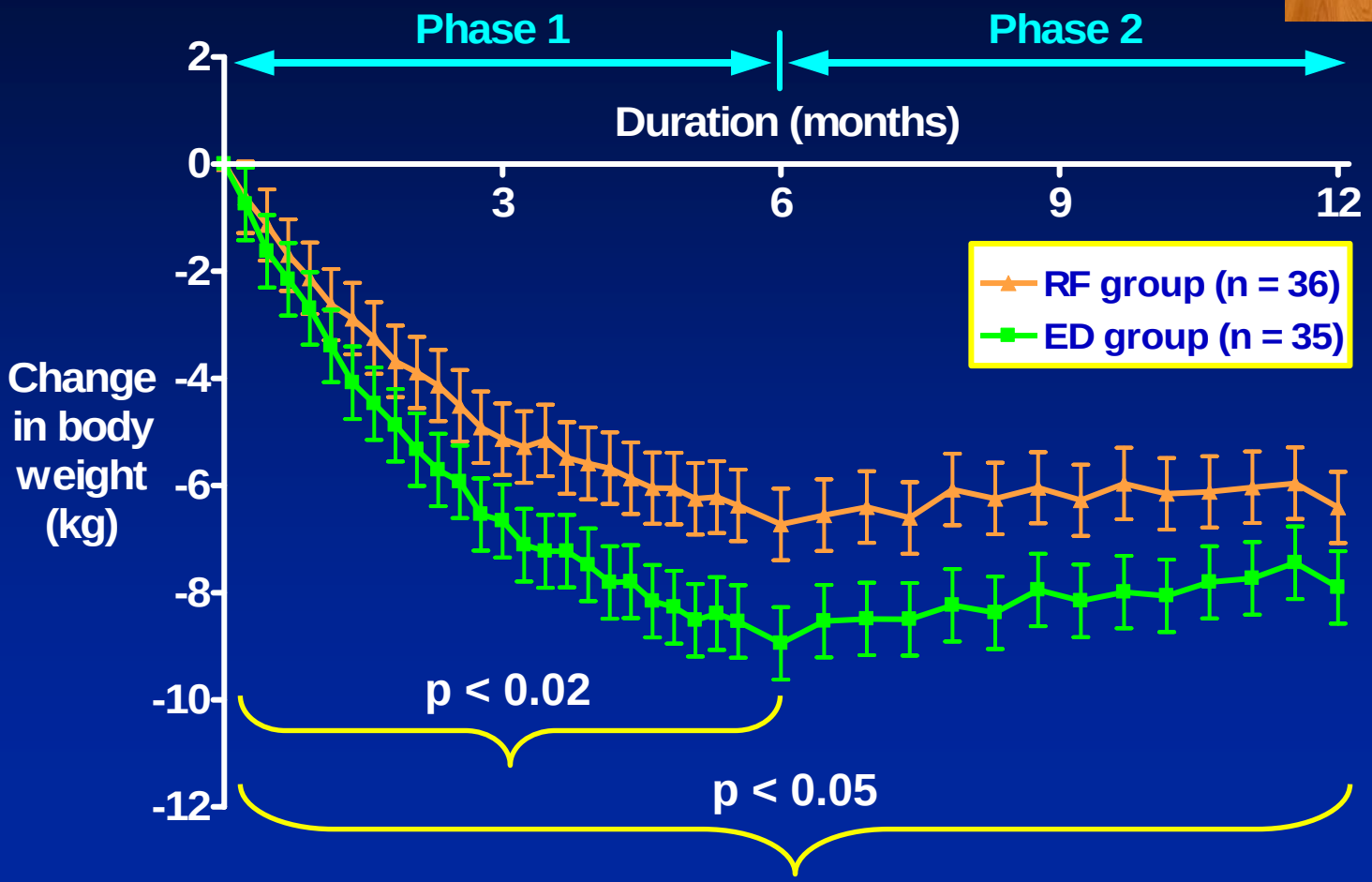
- Reduce fat intake and restrict portions

ED Group:

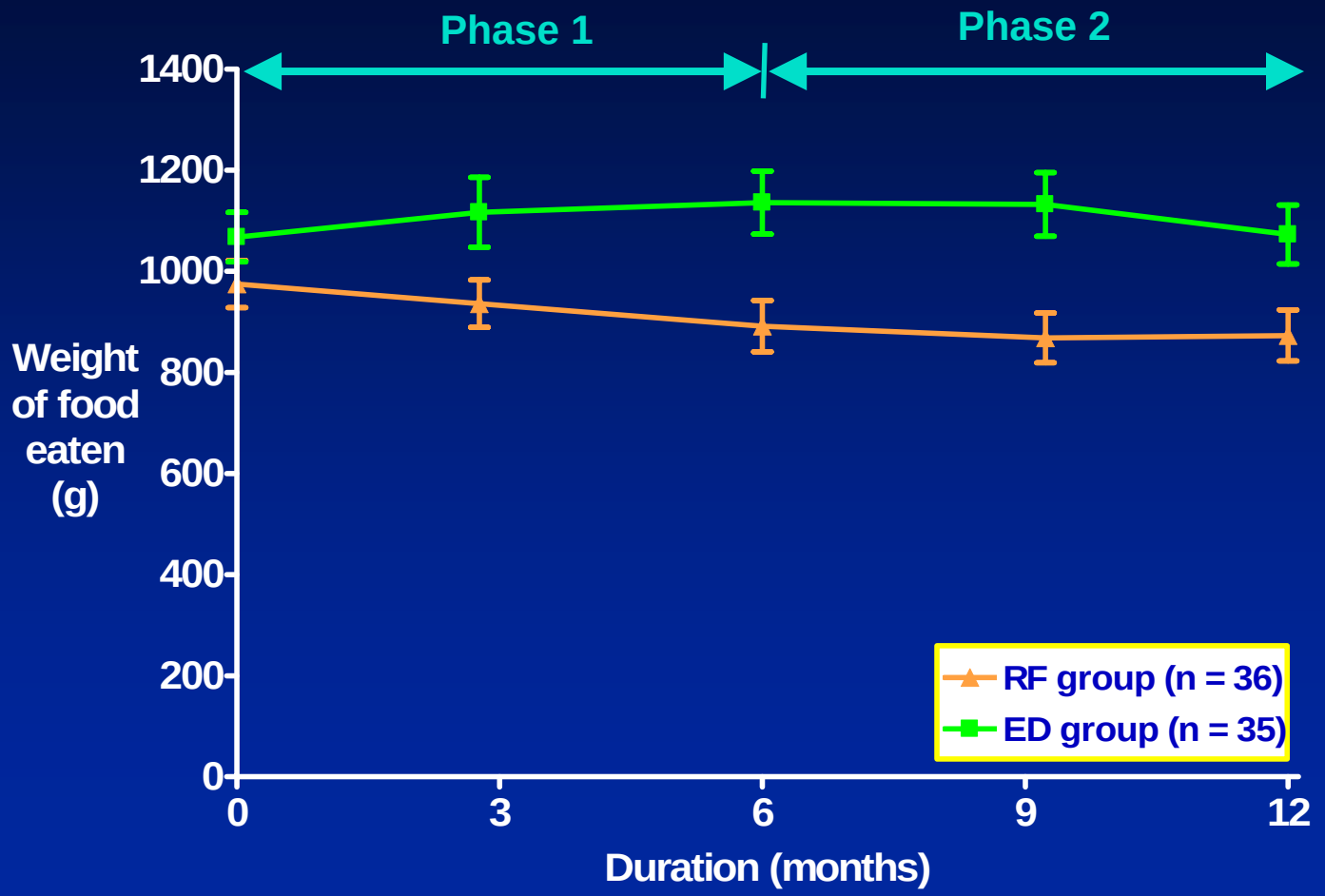
- Increase intake of high-water/high-fiber foods
  - Vegetables, fruits, soups
- Emphasize portion control only for energy-dense foods
  - High-fat foods and foods with low moisture content

Neither group counted calories or fat grams

Both groups were successful, but the ED group lost more weight



The group consuming the lower ED diet ate a greater weight of food and reported less hunger



Main effect of group $p < 0.0025$

Strategies to manage portion size

- Increase variety and availability of low-energy-dense foods
- Increase intake of high-water/high-fiber foods
  - Vegetables, fruits, soups
  - Whole grains and legumes
- Emphasize portion control for energy-dense foods
  - High-fat foods
  - Foods with low moisture content
- Need innovative strategies to modify foods to give consumers satisfying portions, good value and taste, and fewer calories